

Appl. No. : 09/851,261
Filed : May 8, 2001

AMENDMENTS TO THE CLAIMS

Please amend the Claims as follows. Insertions are shown underlined while deletions are ~~struck through~~. Please add Claims 13 and 14.

1 (currently amended): A laser welding head-controlling system comprising:
a laser irradiating body with a laser inlet and a laser outlet that directs a laser spot at a welding seam,

a plurality of semiconductor lasers to oscillate a plurality of linear laser beams configured to direct said plurality of the linear laser beams at ~~the laser spots~~said welding seam or at a region already welded for measuring a welding state during or after a welding process,

a CCD camera with a band-pass filter therein to pass through only reflected laser beams from said linear laser beams and to take in, as an image, said welding state, and

an image processor to process said image relating to said welding state.

2 (original): A laser welding head comprising a laser welding head-controlling system as defined in claim 1, a laser oscillator to oscillate a laser for welding and a condenser to converge the oscillated laser.

3 (previously presented): A method for controlling a laser welding head comprising the steps of:

irradiating a plurality of linear laser beams onto parts during or after a welding process to detect a welding state of the parts,

taking, as an image, said welding state on laser beams reflected by the parts into a CCD camera,

processing said image relating to said welding state, and

controlling a laser welding head based on process data relating to said image.

4 (original): A method for controlling a laser welding head as defined in claim 3, wherein the laser welding head is controlled by the CAD data of the parts to be welded.

5 (previously presented): A method for controlling a laser welding head as defined in claim 3, further comprising the step of monitoring welding defects of the parts to be welded based on the process data and the CAD data.

6 (previously presented): A method for controlling a laser welding head as defined in claim 4, further comprising the step of monitoring welding defects of the parts to be welded based on the process data and the CAD data.

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7 (previously presented): A laser welding head-controlling system for controlling the position of a laser welding head with respect to a target area of objects to be welded, comprising:

at least two semiconductor lasers for emitting linear laser beams configured to be crisscrossed over a seam line at a predetermined angle at the target area or at a region already welded for detecting a welding state during or after a welding process;

a CCD camera provided with a band-pass filter, through which linear laser beams reflected by the objects pass exclusively, to generate an image of the target area; and

an image processor for processing the image of the target area to determine the progress of welding, thereby controlling the position of a laser welding head.

8 (original): The laser welding head-controlling system according to Claim 7, further comprising a CAD data system which stores CAD data of the objects, said data being used to control the position of the laser welding head.

9 (original): A laser welding head comprising the laser welding head-controlling system of Claim 7, a laser oscillator to oscillate a laser for welding, and a condenser to converge the oscillated laser.

10 (previously presented): A method for controlling the position of a laser welding head with respect to a target area of objects to be welded, comprising the steps of:

emitting at least two linear lasers beams so as to be crisscrossed over a seam line at a predetermined angle toward the target area during or after a welding process to detect a welding state of the target area;

generating an image of the target area exclusively from linear laser beams reflected by the objects passing through a band-pass filter, using a CCD camera provided with the band-filter;

processing the image of the target area to determine the progress of welding; and
controlling the position of the laser welding head.

11 (original): The method according to Claim 10, further comprising using CAD data of the objects to control the position of the laser welding head.

12 (previously presented): The laser welding head-controlling system according to Claim 1, wherein at least one of said semiconductor lasers is on a side of said laser outlet opposite another one of said semiconductor lasers.

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13 (new): The laser welding head-controlling system as defined in claim 1, wherein each of said plurality of the semiconductor lasers is configured to direct its linear laser beam at said welding seam or said region already welded so as to be orthogonal to said welding seam or said region.

14 (new): The method for controlling a laser welding head as defined in claim 3, wherein the step of irradiating comprises irradiating each of said plurality of the linear laser beams at a welding seam of said parts so as to be orthogonal to said welding seam.

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SUMMARY OF INTERVIEW

Applicant wishes to thank the Examiner for the courteous telephone interview extended to their representatives that was conducted on July 21, 2004. No exhibits or demonstrations were shown.

Identification of Claims Discussed

Claims 1 and 3 were discussed.

Identification of Prior Art Discussed

Iwai (US 5,533,146) currently cited by the Examiner and JP 04-55078 previously cited by the Examiner were discussed.

Proposed Amendments

Previously presented Claims 1 and 3 were discussed.

Principal Arguments and Other Matters

Applicant's representatives explained that Claim 1 reciting a laser welding head-controlling system and Claim 3 reciting a method for controlling a laser welding head could be distinguished from the invention of Iwai. That is, the claimed invention employs a plurality of semiconductor lasers to oscillate a plurality of linear laser beams, whereas Iwai employs a single semiconductor laser 5. Applicant's representatives also explained the advantages obtained by the plurality of linear laser beams.

The Examiner asked Applicant's representatives to explain the difference between the claimed invention and JP 04-55078 previously cited. JP 04-55078 discloses the semiconductor lasers 28, 33 disposed upstream of a welding head 23 and used to detect a welding seam 22 before the seam is welded (in other word, to detect the condition (positions) of the workpieces to be welded before the welding process). It is impossible to measure a welding state because welding has not occurred. JP 04-55078 simply teaches positioning control of a welding head. In contrast, in the present invention, the semiconductor lasers are disposed for measuring a welding state during or after a welding process.

Results of Interview

The Examiner stated that Claims 1 and 3 are distinguished from the above references.